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The Evolution of the 11th Graders' Mental Models of Ideal Gas

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Abstract

Students often face tremendous challenges when learning ideal gas concepts. This is probably because it is difficult for students to experience the microscopic concepts in ideal gas models in their daily observations, and several misconceptions or alternative concepts occur as a result. Thirty-nine Grade 11 students participated in this study. Students were exposed to eight 50-min teaching periods, 14 students (8 males and 6 females) were interviewed, and their verbal and drawing data were collected. This study analyzed concepts related to ideal gas (particle view, gas volume definition, pressure effect, factors affecting pressure, rigid particles, and the distribution and motion of gas particles) in 14 students by using verbal and graphic data retrieved from 3 interviews (before, during, and after instruction). We also analyzed types of ideal gas mental models that the students use, and the evolutionary processes they follow. The results indicate that dynamic particle model concrete teaching aids, ideal gas model slides, and a computer animation and simulation program changed the 14 student conceptions of gas particle views, rigid particles, and the distribution and motion of gas particles. However, 2 incorrect conceptions—causes of gas pressure and factors of gas pressure—hardly changed and even regressed to their pre-instruction conceptions. The evolution of mental models shows that only one student used the scientific model before instruction. After 4 periods of multi-representational modeling teaching activities, 11 students changed their conceptions from incorrect ideal gas models to scientific models (12 students or 85.7%). Of the 11 students, 2 students reverted to the weight model, 1 student used the attractive force model, and 8 students still held the scientific model after 8 teaching periods.

Keywords: mental models, multi-representational modeling teaching, gas particle models

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